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SHELLED-PEANUT SAMPLER FOR USE IN AUTOMATIC DUMP SCALES

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SHELLED-PEANUT SAMPLER FOR USE IN AUTOMATIC DUMP SCALES

By Whit O. Slay[1]

ABSTRACT

A modified version of an existing shelled-peanut sampler was developed to reduce the time and labor requirements of the conventional methods of sampling bags and bulk-box containers. This device, which collects samples of shelled peanuts as they are weighed through an automatic dump scale, was constructed for less than $50 in 1976. It is operated by the action of the dump-scale gate counterweight and requires no outside source of power. The mechanism can be easily adjusted to provide the same sample weight of peanuts from lot sizes that vary from 300 to 800 bags. This sampler effectively reduces the time and labor required to obtain samples from lots of shelled peanuts and provides an acceptable solution to a sampling problem in shelling plants. **KEYWORDS: peanuts (shelled), peanut processing, peanut sampling, sampler design, sampling methods, scales.**

INTRODUCTION

Shelled peanuts are commonly marketed in quantities called lots. Each lot is identified by number and may vary in size from 300 to 800 bags (approximately 30,000 to 100,000 pounds). Lot identity is maintained until an end user processes the peanuts. Samples for grade determination and aflatoxin assay are collected from each lot of shelled peanuts by the Federal-State Inspection Service.[2] The samples are normally collected by probing 25 percent of the bags in a lot with a device called a hand trier. Conditions under which the samples are collected often make this method strenuous and time consuming.

In 1975, regulations were changed, and the size of the sample required for grade determination and aflatoxin assay was increased from 50 to 150 pounds. The labor required to collect the larger sample posed a serious problem, and it was further complicated by the increased use of 2,000-pound bulk-box containers in place of bags for storage and shipment. The bulk boxes had to be sampled manually as they were filled.

As a result of these conditions, a sampling method was needed to collect the 150-pound sample from various lot sizes that would eliminate the excessive time and labor required for bag and bulk-box sampling. The Federal-State Inspection Service requested that Agricultural Research Service's National Peanut Research Laboratory at Dawson, Ga., redesign, modify, and test an existing device that was used for collecting small samples as peanuts were weighed through an automatic dump scale. This sampling device[3] had proven reliable in collecting small samples and appeared to be an adaptable solution in reducing the existing labor requirements.

[1] Industrial engineer, National Peanut Research Laboratory, Agricultural Research Service, U.S. Department of Agriculture, Dawson, Ga. 31742.

[2] A cooperative inspection agency formed by agreement between State departments of agriculture and USDA. Participating USDA personnel are employees of the Food Safety and Quality Service.

[3] A modified version of a sampler developed by Melvin and Wilbur Shell of Gorman, Tex.

SHELLED-PEANUT SAMPLER

Design and Construction

An assessment of standard pipe sizes indicated that 2½- and 3-inch (i.d.) pipe could be used without need of machining for fit. The 2½-inch pipe was also large enough to obtain the opening width of 1¾ inches that was needed to collect samples from all bag-lot sizes. A sampler was constructed from these pipe sizes and consisted of the following three sections: (1) the outside-pipe assembly (fig. 1), (2) the inside-pipe assembly (fig. 2), and (3) the gate assembly (fig. 3). All parts except the threaded rod, which was machined, were purchased or made from standard stock. A pictorial drawing (fig. 4) shows how the sampler fits together and also gives a complete bill of materials. The cost of the sampler in 1976 was less than $50 in quantity lots.

Installation

The sampler was installed in an automatic dump scale of the suspended-weighing-bin type that is common to many shelling plants. Installation was not difficult, but care was required to mount the sampler so that no problems were posed in collecting the required number of grams for each sample from bags of different weights. The method used to determine the places to cut the mounting holes for the sampler was as follows. (1) The gate was opened until the counterweight rested against the scale wall. (2) A line was marked on the scale wall along the top of the counterweight. (3) A check was made to be sure that the high point of the arc traversed by the gate counterweight would occur at the scale wall and not at some point along the sampler pipe. (4) Mounting holes were located above the marked line for the 3-inch pipe and below the line for the ½-inch pushrod pipe so that in operation the gate counterweight would contact the pushrod and clear the 3-inch pipe and the bottom of the mounting plate.

If this installation procedure is followed, results with the suspended-weighing-bin scale indicate that the correct size of sample can be collected from smaller weight bags, such as the 50-kilogram export bag. If different installation procedures are required, the point to remember is that the depth of peanuts above the sampler determines the size of sample that can be collected. The position of the sampler in the scale should maximize this depth.

Operation

Figure 5 shows the sampler and the gate counterweight in the closed and activated positions. In the closed position, the sampler is covered by peanuts flowing into the dump-scale hopper. When the trip weight is reached, the scale gate begins to open, and peanuts start flowing from the hopper. A slight clearance between the sampler pushrod and the gate counterweight allows the peanuts in the hopper to begin moving before the sampler is activated. This clearance was included because of an assumption that pushing the sampler into moving peanuts would reduce the possibility of damage.

Shortly after the gate begins to open, the counterweight contacts the pushrod and slides the inner pipe out of the outer pipe. This exposes the opening in the inner pipe to the peanuts. A few grams of peanuts, depending on the size of the set opening, fall into the inner pipe and are gravity-fed to the outside of the scale for collection.

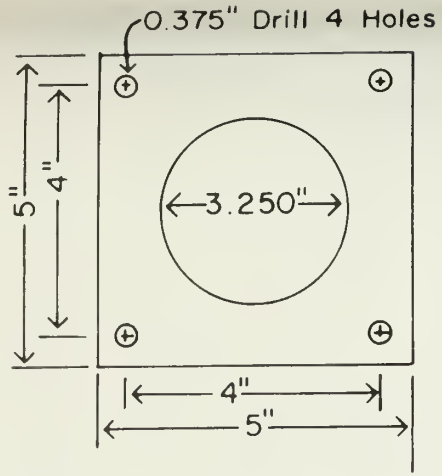
Calibration

The grams of peanuts needed from each dump of 125 pounds to obtain 150 pounds of sample for the 300- and 800-bag lots were determined to be 85 and 227 grams, respectively. Starting at a 1-inch sampler opening, the opening sizes were increased in ½-inch increments until the desired range of 85 to 227 grams of peanuts was covered. Ten replications were run for each opening size. At the 1- and 3-inch openings, respectively, averages of 65 and 249 grams of peanuts were collected from each dump.

A regression curve (fig. 6) shows the effect of gate opening on sample size. Data points, mean sample weights, and standard deviations are given for each size opening tested.

It was assumed that each sampler installation in a shelling plant might differ slightly in operation and thus require calibration. To reduce the time and effort necessary for calibration, a guide was prepared from the data obtained with the test sampler. The bag-lot sizes in 50-bag increments (from 300 to 800 bags),

(*Continued on page 10.*)



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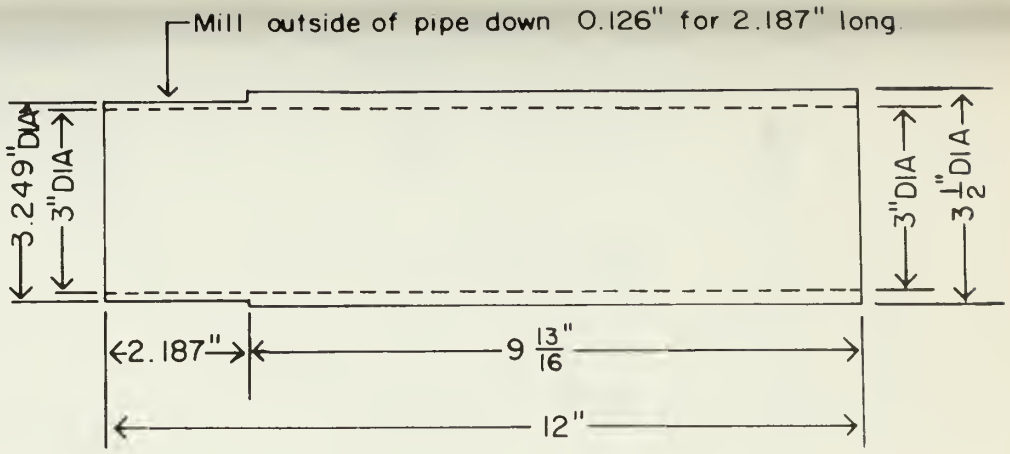

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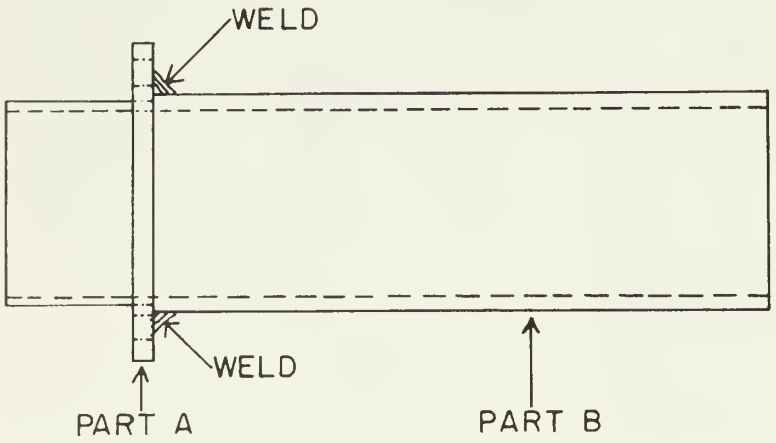


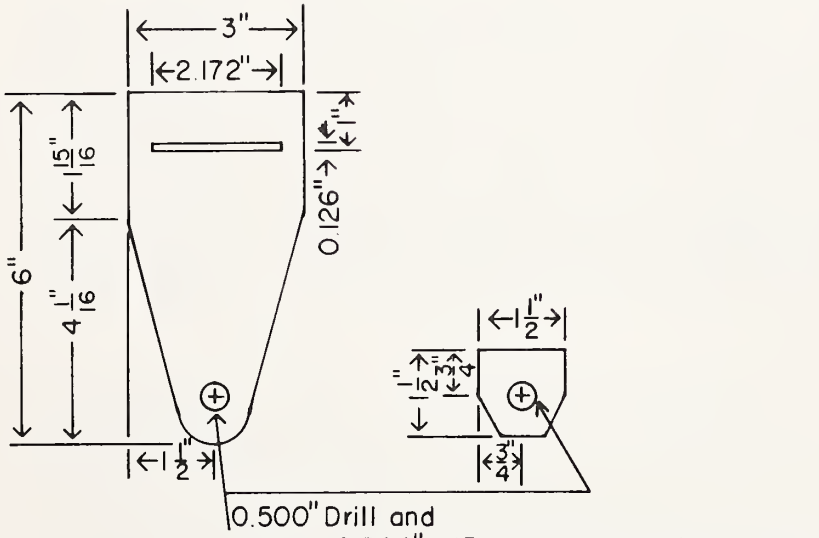
Bill of Materials

Part no.	Number required	Description
Part A	1	$\frac{3}{16}$" thick steel plate 5" x 5"
Part B	1	$3\frac{1}{2}$" outside diameter, black pipe

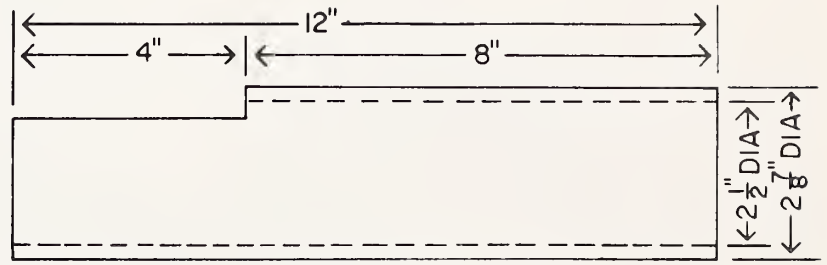
Notes:

1. Mill outside of pipe down 0.126" for 2.187" long.

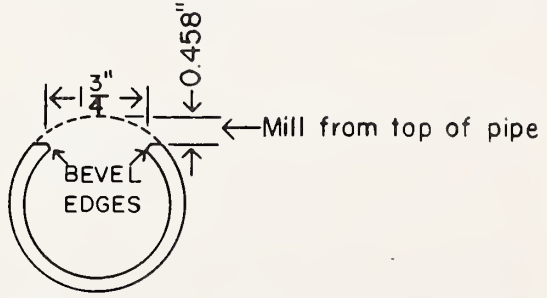
FIGURE 1.—Outside-pipe assembly.



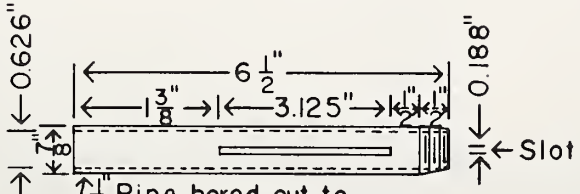
PART C PART D



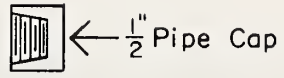
PART E



OPENING DETAIL FOR INSIDE PIPE PART E



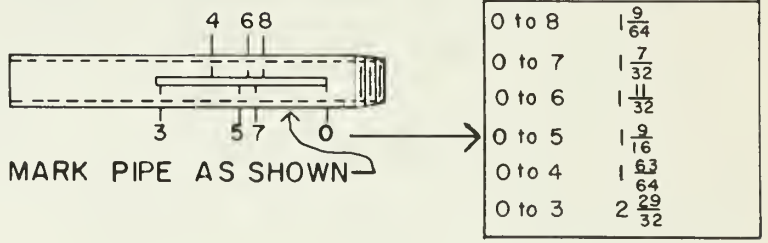
PART F



PART G

Bill of Materials

Part no.	Number required	Description
Part C	1	6" X 3" X $\frac{1}{4}$" Flat steel plate
Part D	1	1 $\frac{1}{2}$" X 1 $\frac{1}{2}$" X $\frac{1}{4}$" Flat steel plate
Part E	1	2 $\frac{7}{8}$" Outside diameter, black pipe
Part F	1	$\frac{1}{2}$" Inside diameter, black pipe
Part G	1	$\frac{1}{2}$" Pipe cap



Notes:

1. Weld part D to part C before drilling and tapping then shape as shown.
2. Weld part F to part D with slot on left side.

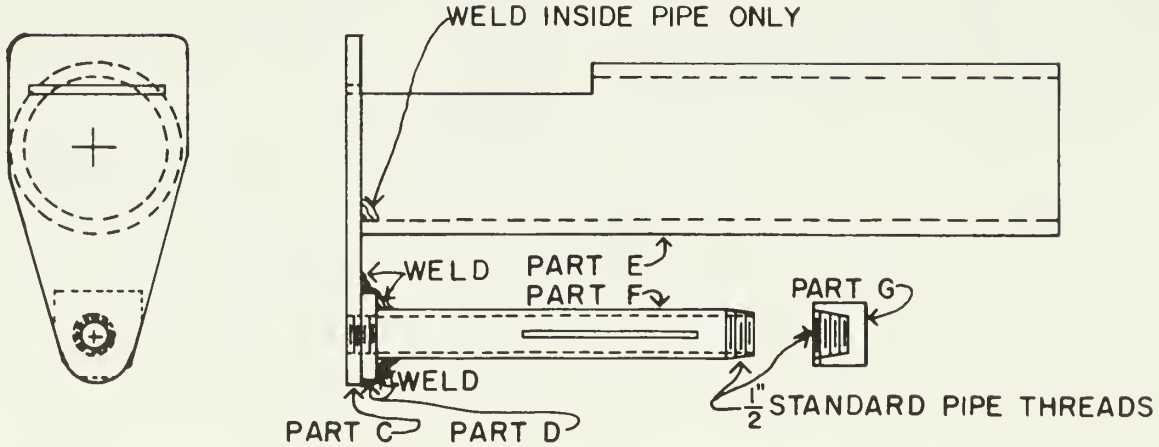
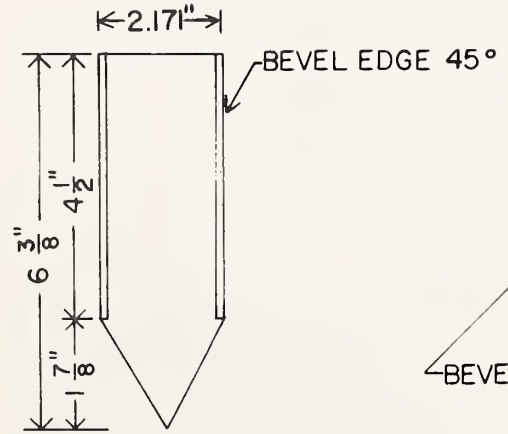
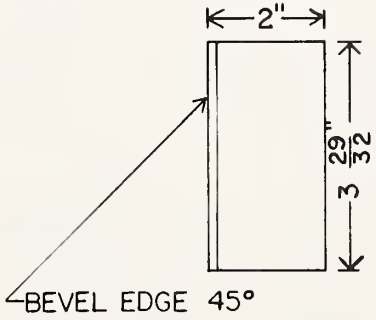


FIGURE 2.—Inside-pipe assembly.



PART H



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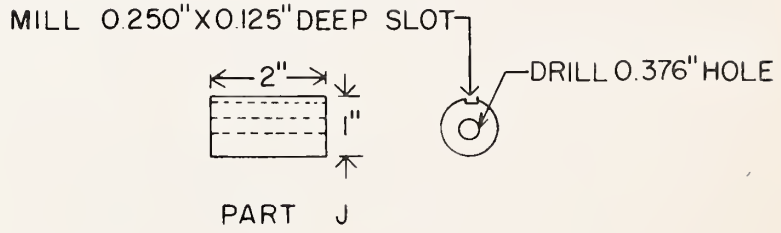

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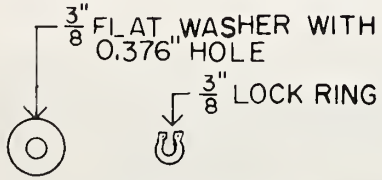
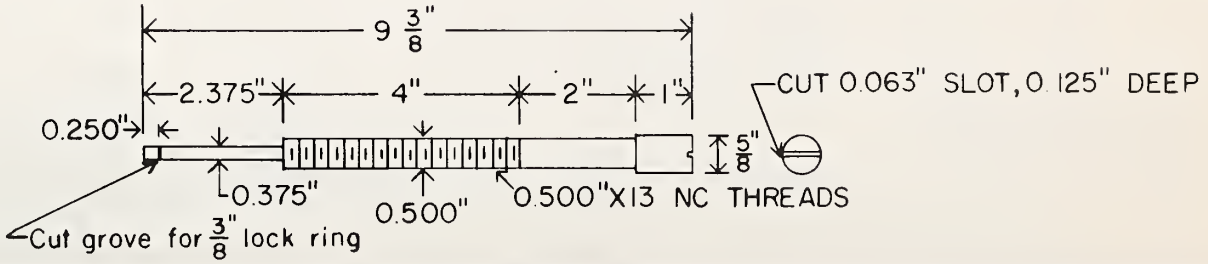
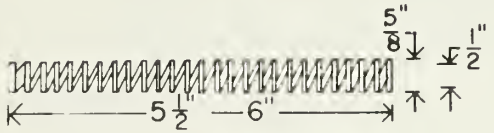


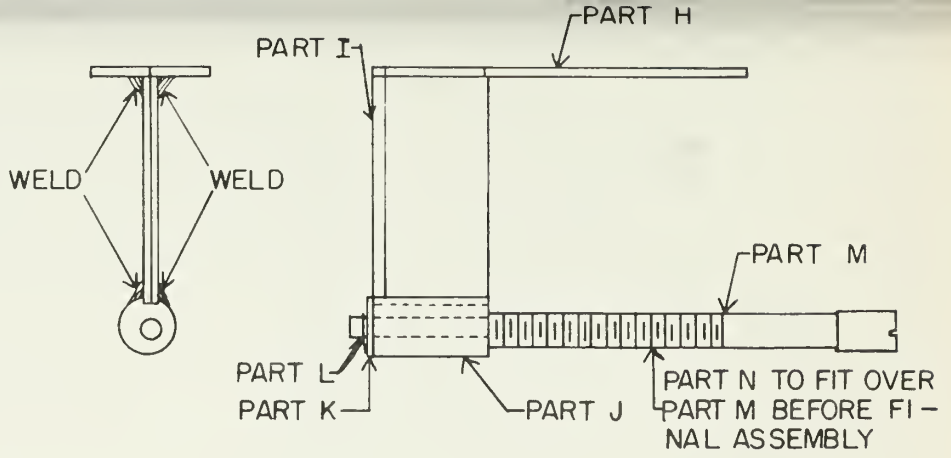
PART K PART L



PART M



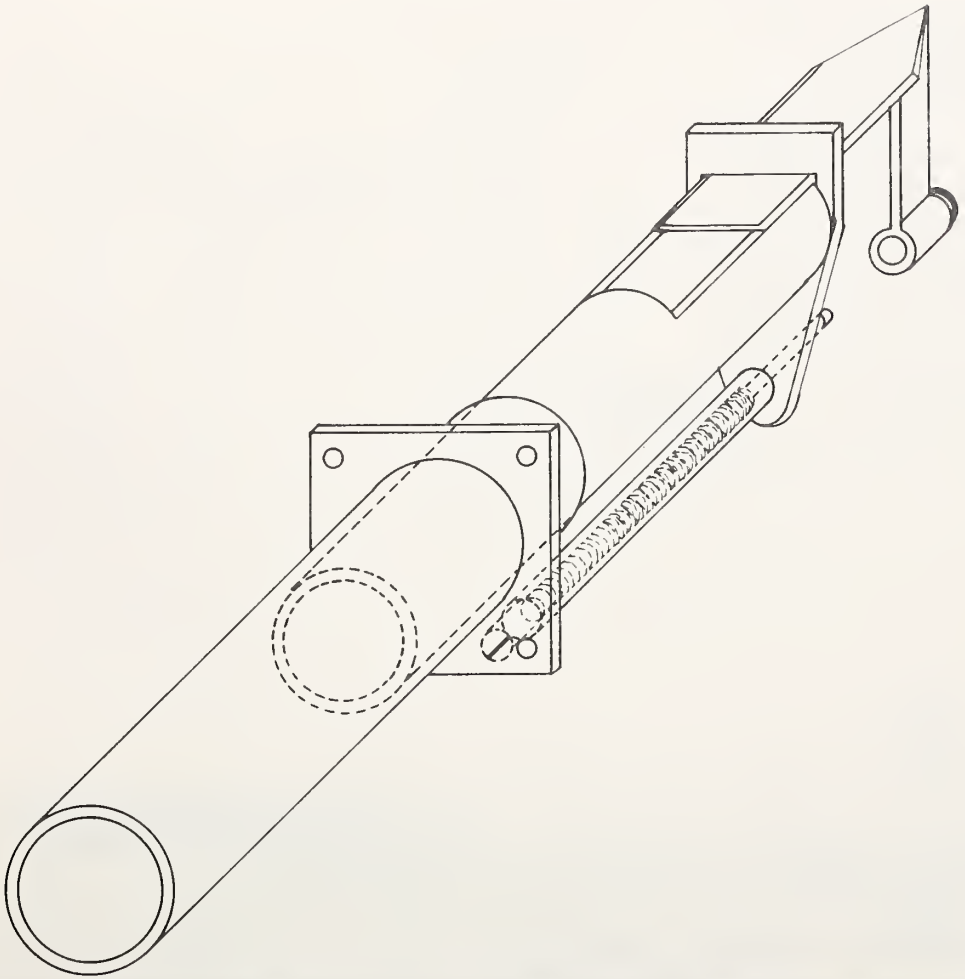
PART N



Bill of Materials

Part No	Number Required	Description
Part H	1	6 3/8" x 2 1/2" x 1/8" Flat Steel Plate
Part I	1	3 29/32" x 2" x 1/4" Flat Steel Plate
Part J	1	1" x 2" Hot Rolled
Part K	1	3/8" Flat Washer
Part L	1	3/8" Lock Ring
Part M	1	5/8" x 9 3/8" Hot Rolled
Part N	1	5 1/2"-6" Compression Spring, 1/2" I.D., 5/8" O.D.

FIGURE 3.—Gate assembly.



Bill of Materials

Part no.	Number required	Description
Part A	1	$\frac{3}{16}$" thick steel plate 5" x 5"
Part B	1	$3\frac{1}{2}$" outside diameter, black pipe
Part C	1	6" x 3" x 1" Flat steel plate
Part D	1	$1\frac{1}{2}$" x $1\frac{1}{2}$" x $\frac{1}{4}$" Flat steel plate
Part E	1	$2\frac{7}{8}$" outside diameter, black pipe
Part F	1	$2\frac{1}{2}$" inside diameter, black pipe
Part G	1	$2\frac{1}{2}$" Pipe cap
Part H	1	$6\frac{3}{8}$" x $2\frac{1}{2}$" x $\frac{1}{8}$" Flat steel plate
Part I	1	$3\frac{29}{32}$" x 2" x $\frac{1}{4}$" Flat steel plate
Part J	1	1" x 2" Hot rolled
Part K	1	$\frac{5}{8}$" Flat washer
Part L	1	$\frac{5}{8}$" Lock ring
Part M	1	$\frac{5}{8}$" x $9\frac{3}{8}$" Hot rolled
Part N	1	$5\frac{1}{2}$" – 6" Compression spring, $\frac{1}{2}$" I.D. $\frac{5}{8}$" O.D.

FIGURE 4.—Assembled view of sampler.

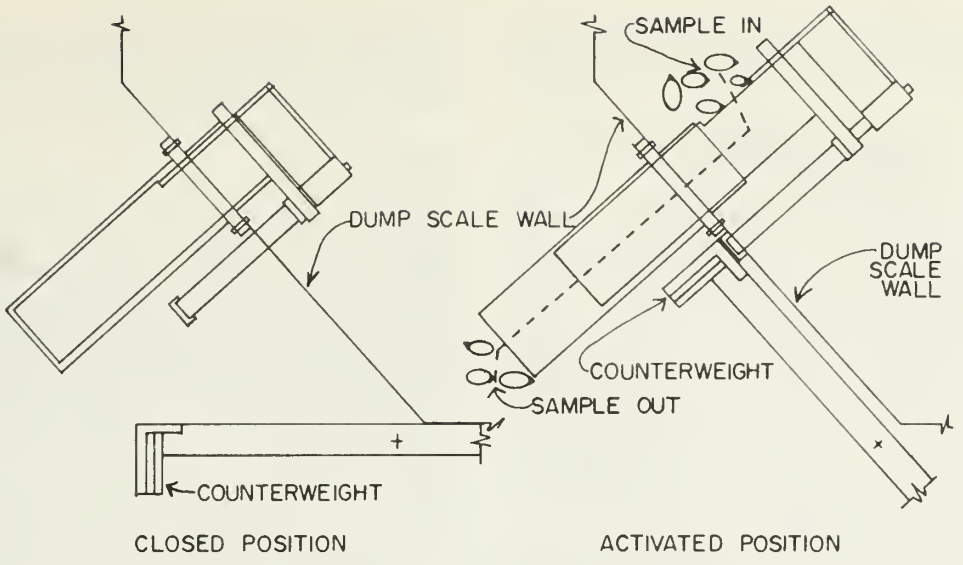


FIGURE 5.—Position of sampler and gate counterweight in closed and activated positions.

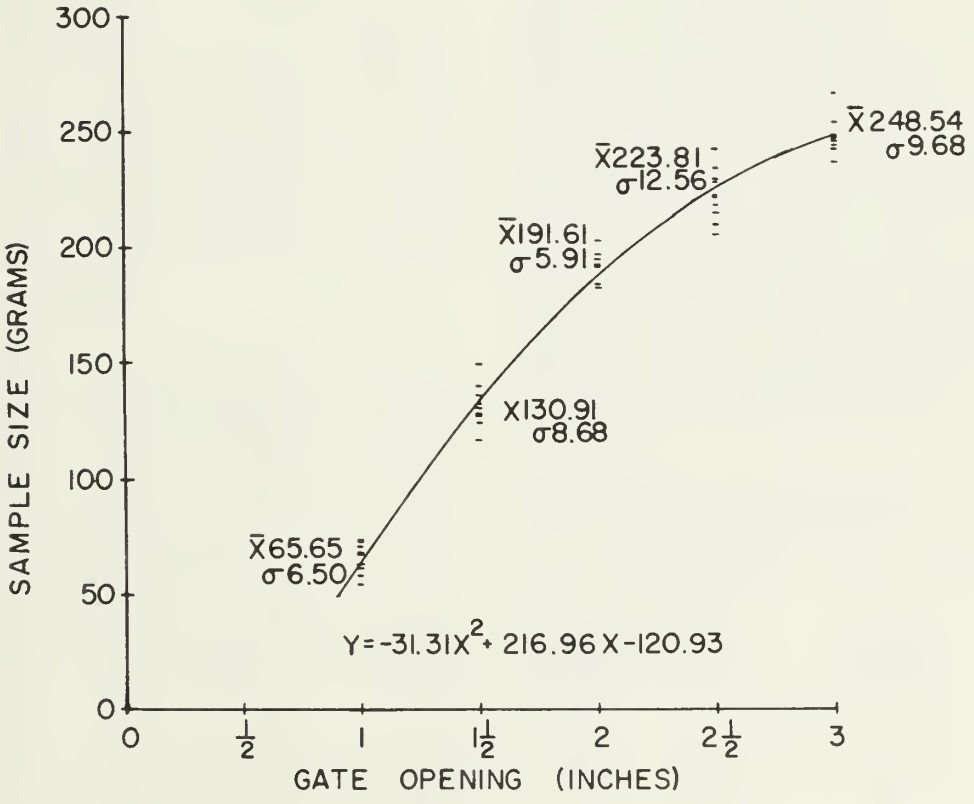


FIGURE 6.—Size of peanut sample collected from each scale dump at the indicated gate openings in the automatic sampler.

the grams of sample needed from each dump, and the sampler opening sizes are given in table 1.

Sample Reliability

A mill-run lot of 'Florunner' peanuts, already well mixed from the shelling and grading process, was run through a mixer to make it as homogeneous as possible. The peanuts were then divided into six test lots (table 2). Each test lot was run through the mixer, and control samples (C) were collected frequently from the stream of peanuts as it flowed into the holding bin. Extreme care was taken in handling the peanuts to prevent damage.

Sampler openings of 1½ and 3 inches were used, and three replications (test lots) were run at each opening size. In each replication 16 bags of peanuts were collected with normal bagging methods. Each bag of peanuts was sampled by the automatic sampler (AS) as the peanuts went through the dump scale and by the hand trier (T) after the peanuts were again bagged. Each bag was then divided by a shelled-stock divider (D) to obtain a 5-pound sample. Bald kernels, split kernels, and fall-through kernels (kernels falling through a 16/64- by ¾-inch slotted screen) were used to compare sampling methods and sampler opening sizes.

An analysis of variance, with the data from both opening sizes combined, showed no interaction between the sampling method and the opening size. In determining the percentages of bald, split, and fall-through kernels, data from the 1½- and 3-inch openings were combined. A comparison of the sampling methods can be made from the data in table 2.

TABLE 1.—*Calibration guide for setting size of sampler opening with automatic dump scale set for dump of 125 pounds*

No. bags per lot	Sample size, each dump (grams)	Sampler opening size	
		Inches	Centimeters
800	85	1⅛	2.9
750	91	1 3/16	3.0
700	97	1¼	3.2
650	105	1 5/16	3.3
600	114	1⅜	3.5
550	124	1 7/16	3.7
500	136	1 9/16	3.9
450	151	1⅝	4.1
400	170	1 13/16	4.6
350	195	2 1/16	5.2
300	227	2 9/16	6.5

Bald kernels

The results do not show a significant difference in bald-kernel content of the samples among the T, D, and C methods of sampling. The AS sampling method was significantly different from the T and D methods, but the C method was intermediate and could be classed with any of the other methods. There was some expectation that the D samples would have the highest bald-kernel content because more han-

TABLE 2.—*Percentages of bald, split, and fall-through kernels in samples collected by four sampling methods*[1]

Test lot No.	Sampling method[2]			
	AS	T	D	C
	Bald kernels			
1	5.20	4.88	5.31	5.73
2	6.22	5.00	4.93	5.00
3	5.08	5.19	4.80	4.53
4	5.95	5.41	4.64	5.36
5	6.86	4.93	5.60	6.08
6	6.37	5.47	5.65	6.05
Mean[3]	5.94b	5.14a	5.15a	5.45ab
	Split kernels			
1	2.37	2.40	2.91	2.07
2	2.00	2.70	3.21	2.36
3	1.76	2.27	2.69	1.52
4	4.63	5.39	5.83	2.18
5	1.98	3.11	3.95	2.38
6	2.99	3.22	3.28	2.60
Mean[3]	2.62a	3.18ab	3.64b	2.18a
	Fall-through kernels			
1	1.62	1.47	1.41	1.55
2	1.90	1.57	1.83	1.51
3	3.45	3.07	2.14	2.60
4	2.47	2.24	2.22	1.71
5	1.21	2.43	2.40	1.40
6	3.57	1.98	2.67	2.83
Mean[3]	2.37a	2.13a	2.11a	1.93a

[1] Combined data for 1½- and 3-inch openings in sampler.

[2] AS = Automatic sampler. T = Hand trier. D = Shelled-stock divider. C = Control.

[3] Means followed by a common letter are not significantly different at the 0.05 level.

dling was required for sample collection. The results disprove this and indicate that this method probably caused more splitting of bald kernels than did the other methods.

Split kernels

The test results do not show a significant difference among the C, AS, and T sampling methods. The D method was significantly different from the C and AS methods. The T sampling method was intermediate and could be classed with any of the other methods. The D method produced the largest mean split-kernel outturn. The same results were found in the individual analysis of each sampler opening. The same order of the means in all cases tends to support the previous assumption that the D sampling method caused more splitting of kernels.

Fall-through kernels

The test data did not show any significant difference in fall-through kernel content of the samples for the four sampling methods. The same results were found in the individual analysis of each sampler opening. This is strongly supportive of the assumption that the AS sampling method has no more or less whole-kernel size bias than the other sampling methods.

Other considerations

The possibility of split-kernel bias was considered. The data do not provide an answer, but the same order of the means in all analyses of split-kernel data seems adequate proof that the AS sampling method did not cause any more splits than did the other methods.

In practice, grade tolerances of ± 0.5 percent may be larger than some of the differences that were found significant in the data. In such instances the differences among sampling methods would not likely have any practical significance.

The peanuts used in these tests were considered below average in quality. Moisture content was 6 percent, and the peanuts were handled very carefully. Even so, the bald and split-kernel content of the samples was high. Regardless of the sampling method used, poor-quality peanuts are more easily damaged, and great care in handling is required to prepare a sample for analysis.

CONCLUSIONS

The sampler effectively reduces the time and labor requirements of conventional methods of sampling bags and bulk-box containers of shelled peanuts.

The sampler must be calibrated for each installation, but after calibration it will repeatedly collect samples within the specified 10-percent weight tolerance. The dump-scale feed bin must be kept sufficiently full of peanuts to maintain normal trickle-gate operation in filling the weighing bin. This is necessary to obtain the required sample weight within the range of the openings specified for the sampler.

As with most sampling methods, the automatic sampler requires a homogeneous mixture of peanuts in order to collect a sample that is representative of the lot. Normally, the shelling-plant processes produce a good mixture, but care must be taken that conveyors used to feed bagging bins, particularly the vibratory type, do not cause segregation of split and whole kernels. If a homogeneous peanut mixture is provided, the automatic sampler will collect a representative sample that is as acceptable as samples drawn by the other sampling methods.

Inspectors in some shelling plants have preferred the spacer arrangement to the threaded-rod arrangement for setting gate openings in the sampler. The cost of building the sampler is approximately the same for either arrangement.

The sampler is a rather simple, inexpensive mechanism that requires no outside energy for operation. It has provided an acceptable solution to a sampling problem in shelling plants.

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